

WHAT IS CLAIMED IS:

- 5
1. A compact disk (CD), comprising:
an audio portion for storing a first two track audio signal
reproducible by playing said CD on a conventional audio CD player; and
a CD-ROM portion, for storing data comprising:
additional audio data; and
control information, wherein said first two track audio signal
and said additional audio data can be combined through use of said control
information to reproduce a unified audio signal.
 2. The CD of claim 1, wherein said unified audio signal
comprises a second two track audio signal of higher resolution than said first two
track audio signal.
 3. The CD of claim 1, wherein said unified audio signal
comprises more than two channels.
 4. A method of storing audio data on a CD, comprising:
storing in the audio portion of said CD a first two track audio signal,
wherein said first two track audio signal is reproducible by playing said CD on a
conventional audio CD player;
5 storing additional audio data on said CD outside of said audio
portion; and
storing control information on said CD, wherein said first two track
audio signal and said additional audio data can be combined through use of said
control information to reproduce a unified audio signal.
 5. The method of claim 4, wherein said unified audio signal
comprises a second two track audio signal of higher resolution than said first two
track audio signal.

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6. The method of claim 4, wherein said unified audio signal comprises more than two channels.

7. A method for storing an audio signal of two or more channels, comprising:

deriving from the audio signal data, comprising:

5 a plurality of digital signals, wherein a first of said plurality of digital signals is a first two track audio signal; and

control information, wherein a reproduction of said audio information can be produced from said plurality of digital signals by use of said control information;

storing said first digital signal on a first medium;

10 storing the remainder of said plurality of digital signals on one or more second media; and

storing the control information.

8. The method of claim 7, wherein said first medium is a rewritable memory.

9. The method of claim 8, further comprising:
compressing said first digital signal prior to storing on said first medium.

10. The method of claim 7, wherein said first medium is the audio portion of a compact disk (CD), wherein said first digital signal can be reproduced on a conventional CD player.

11. The method of claim 10, wherein said one or more second media is the CD-ROM portion of said CD.

12. The method of claim 11, wherein said control information is stored in the CD-ROM portion of said CD.

13. The method of claim 7, wherein said audio signal audio comprises more than two channels.

14. The method of claim 7, wherein said reproduction of said audio signal comprises a second two track audio signal of higher resolution than a reproduction based on said first two track audio signal alone.

15. A method for reproducing media stored audio information, comprising:

reading a first medium to extract therefrom a first two track audio signal;

reading information from one or more second media to extract therefrom data comprising:

one or more second audio signals; and
control information;

reproducing said audio information from said first and second audio signals by use of said control information.

16. The method of claim 15, wherein said first medium is a rewritable memory.

17. The method of claim 16, wherein said first two track audio signal is compressed, further comprising:

decompressing said first two track audio signal prior to reproducing said audio information.

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18. The method of claim 15, wherein said first medium is the audio portion of a compact disc (CD), wherein said two track first audio signal can be reproduced on a conventional CD player.

19. The method of claim 18, wherein said one or more second media is the CD-ROM portion of said CD.

20. The method of claim 19, wherein the reading the audio portion and said reading information from the CD-ROM portion are performed concurrently.

21. The method of claim 15, wherein said audio information comprises more than two channels.

22. The method of claim 15, wherein said reproducing results in a reproduction of said audio information comprising a second two track audio signal of higher resolution than said first two track audio signal.

23. An apparatus for the augmented playback of a compact disc (CD), wherein said CD includes a conventional two channel audio portion reproducible on a conventional CD player, comprising:

a random access CD transport to read said CD;

a first buffer memory connected to said random access CD transport, wherein said first buffer memory stores data read from said audio portion;

a second buffer memory, wherein said second buffer memory stores augmentation data including:

additional audio information; and

control information;

a control processor connected to said second buffer memory; and

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15 a digital signal processor connected to said control processor and said first and second buffer memories, wherein said digital signal processor produces an augmented output signal by combining said additional audio information with said data read from said audio portion through use of input derived by said control processor from said control information.

24. The apparatus of claim 23, further comprising:
an external input connected to said second buffer memory to provide said augmentation data.

25. The apparatus of claim 23, wherein said random access CD transport is connected to said second buffer memory to provide said augmentation data read from the CD-ROM portion of said CD.

26. The apparatus of claim 25, wherein said control processor is connected to said random access CD transport, whereby said control processor controls the reading of said CD so that said audio portion and said CD-ROM portion are read concurrently.

27. The apparatus of claim 26, further comprising:
an external input connected to said second buffer memory to provide said augmentation data.

28. The apparatus of claim 23, further comprising:
a digital to analogue converter connected to said digital signal process, whereby said augmented output signal is converted to an analog output.

29. The apparatus of claim 23, wherein said first and second buffer memories are contained within a single memory.

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The apparatus of claim 1, wherein the processor contained within the recording device is configured to:

The apparatus of claim 1, wherein the recording device has more than two channels.

The apparatus of claim 1, wherein the recording device has two channel output signals, and the recording device is configured to reproduce the portion is reproduced on the recording device.

A method for recording a digital audio signal, comprising:

recording a master recording of a digital audio signal;

reducing the master recording to a reduced digital audio signal;

recording the reduced digital audio signal;

recording additional information associated with the reduced digital audio signal;

recording a residual dependent on the reduced digital audio signal;

recording control information associated with the reduced digital audio signal;

recording the residual with said reduced digital audio signal;

recording said residual; and

recording said control information.

The method of claim 1, wherein the recording device is a standard CD player.

32. The apparatus of claim 23, wherein said augmented output signal comprises a two channel output signal of higher-resolution than when said two channel audio portion is reproduced on a conventional CD player.

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deriving from said master recording a reduced digital reproduction

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forming additional information, comprising:

a residual dependent upon the difference between said master

control information, including data that can be used to

recording said control information.

34. The method of claim 33, wherein the recording of said reduced digital reproduction is performed onto the audio portion of a compact disk (CD) playable on a standard CD player.

35. The method of claim 34, wherein the recording of said residual and the recording said control information are performed onto the CD-ROM portion of said CD.

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36. The method of claim 34, wherein said master recording is a digital recording characterized by an original sampling frequency, and wherein the deriving of said reduced digital reproduction comprises downsampling said master recording to a lower sampling frequency.

37. The method of claim 36, further comprising:
upsampling said reduced digital reproduction to said original sampling frequency prior to forming said residual.

38. The method of claim 34, wherein said master recording is a digital recording characterized by an original number of bits per sample, and wherein the deriving of said reduced digital reproduction comprises truncating said master recording to a lesser number of bits per sample.

39. The method of claim 34, wherein said master recording is characterized by an original sampling frequency and by an original number of bits per sample, and wherein the deriving of said reduced digital reproduction comprises downsampling said master recording to a lower sampling frequency and truncating the resultant signal to a lesser number of bits per sample.

40. The method of claim 39, further comprising:
upsampling said reduced digital reproduction to said original sampling frequency prior to forming said residual.

41. The method of claim 37, further comprising:

adding dither to said reduced digital reproduction subsequent to downsampling said master recording but prior to recording reduced digital reproduction.

B. 42. The method of claim 41, wherein said dither is reversible, further comprising:

subtracting said dither prior to upsampling said reduced digital reproduction.

43. The method of claim 38, further comprising:
adding dither to said reduced digital reproduction prior to truncating said master recording.

44. The method of claim 43, wherein said dither is reversible, further comprising:

subtracting said dither prior to forming said residual.

45. The method of claim 40, further comprising:
adding dither to said reduced digital reproduction prior to truncating said resultant signal.

46. The method of claim 45, wherein said dither is reversible, further comprising:

subtracting said dither prior to upsampling said reduced digital reproduction.

47. The method of any of claims 42, 44, or 46, wherein said control information further includes data which characterize how said dither can be reversed.

48. The method of claim 34, further comprising:
compressing said residual prior to its recording.

49. The method of claim 48, wherein said control information further includes data on how the compressing is performed.

50. The method of claim 33, wherein the recording of said reduced digital reproduction is performed onto a rewritable memory.

51. The method of claim 50, further comprising:
compressing said reduced digital reproduction prior to its recording.

52. A compact disk (CD), comprising:
an audio portion wherein is stored a first two track digital representation of a master recording, wherein said digital representation is reproducible by playing said CD on a conventional audio CD player; and
a CD-ROM portion, wherein is stored data comprising:
control information; and
additional audio information, wherein said first two track digital representation and said additional audio information can be combined through use of said control information to reproduce second two track digital representation of said master recording, wherein said second representation is higher-resolution than said first representation.

53. The CD of claim 52, wherein said additional audio information is compressed.

54. The CD of claim 53, wherein control information contains data on how said additional audio information is compressed.

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55. The CD of claim 52, wherein said first two track digital representation is a dithered representation produced by a reversible dithering process, wherein said control information contains data used to perform said reversible dithering process.

56. A method of storing high-resolution audio data on a CD, comprising:

storing in the audio portion of said CD a first two track digital representation of said high resolution audio data, wherein said first two track digital representation is reproducible by playing said CD on a conventional audio CD player;

storing control information on said CD; and

storing additional audio data on said CD outside of said audio portion, wherein said first two track digital representation and said additional audio information can be combined through use of said control information to reproduce second two track digital representation of said high resolution audio data, wherein said second representation is higher-resolution than said first representation.

57. The method of claim 56, wherein said additional audio data is stored in the CD-ROM sector of said CD.

58. The method of claim 56, wherein said additional audio data is compressed.

59. The method of claim 58, wherein control information contains data on how said additional audio information is compressed.

60. A method for reproducing two track, high-resolution audio signal, comprising:
reading a lower resolution representation of said audio signal;

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reading additional information, comprising:

additional audio information derived from said audio signal;
reconstructing said two track, high-resolution audio signal from said
lower resolution representation and additional audio information by use of said
control information.

61. The method of claim 60, wherein said lower resolution representation is contained in the audio portion of a compact disk (CD) in a manner reproducible on a standard CD player.

62. The method of claim 61, wherein said additional information is contained in the CD-ROM portion of said CD.

63. The method of claim 61, wherein said high-resolution audio signal is characterized by an original sampling rate, further comprising:
upsampling said lower resolution representation to said original sampling rate prior to reconstructing said two track, high-resolution audio signal.

64. The method of claim 63, further comprising:
subtracting reversible dither from said lower resolution representation
prior to said upsampling.

65. The method of claim 62, further comprising:
subtracting reversible dither from said lower resolution representation
prior to reconstructing said two track, high-resolution audio signal.

66. The method of either of claim 64 or 65, wherein the subtracting of reversible dither is performed using data extracted from said control information.

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67. The method of claim 61, where
compressed, further comprising:
expanding said additional audio information
n-resolution audio signal.

68. The method of claim 67, where
o is performed using data extracted from

69. The method of claim 60, where
is contained in a rewritable memory.

70. The method of claim 69, where
is compressed, further comprising:
expanding said lower resolution representation
high-resolution audio signal.

71. A method for storing an N-channel
reater than two, comprising:
deriving from said N-channel audio
recording said two channel representation
forming additional information, comprising
a residual dependent upon the d
signal and said two channel representation
control information, including d
residual with said two channel representa
entation of said N-channel audio signal, wh
than N;
recording said residual on one or more se

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69. The method of claim 60, wherein the method is contained in a rewritable memory.

70. The method of claim 69, wherein the method is compressed, further comprising:
expanding said lower resolution representation to a high-resolution audio signal.

71. A method for storing an N-channel audio signal greater than two, comprising:
deriving from said N-channel audio signal a lower resolution representation of the audio signal.

70. The method of claim 69, wherein the audio signal is compressed, further comprising:
expanding said lower resolution representation to form a high-resolution audio signal.

71. A method for storing an N-channel audio signal, where N is greater than two, comprising:
deriving from said N-channel audio signal a two channel representation;
recording said two channel representation;
forming additional information, comprising:
a residual dependent upon the difference between said N-channel audio signal and said two channel representation.

expanding said lower resolution representation to produce a high-resolution audio signal.

71. A method for storing an N-channel audio signal, where N is greater than two, comprising:

deriving from said N-channel audio signal a two channel representation;

recording said two channel representation;

forming additional information, comprising:

a residual dependent upon the difference between said N-channel audio signal and said two channel representation;

control information, including data for

71. A method for storing an N-channel audio signal, where N is greater than two, comprising:

deriving from said N-channel audio signal a two channel representation of said audio signal;

recording said two channel representation of said audio signal;

forming additional information, comprising:

a residual dependent upon the difference between said audio signal and said two channel representation of said audio signal;

control information, including data for reproducing said residual with said two channel representation of said audio signal;

storing said two channel representation of said N-channel audio signal, where N is greater than N;

deriving from said N-channel audio
recording said two channel representation
forming additional information, comprising
a residual dependent upon the d
signal and said two channel representation
control information, including d
residual with said two channel representa
entation of said N-channel audio signal, wh
than N;
recording said residual on one or more se
recording said control information.

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a residual dependent upon the d
signal and said two channel representation
control information, including d
residual with said two channel representa
entation of said N-channel audio signal, wh
than N;
recording said residual on one or more se
recording said control information.

recording said residual on one or more secondary
recording said control information.

72. The method of claim 71, wherein said first media is the audio portion of a compact disk (CD), wherein said two channel representation can be reproduced on a conventional CD player

73. The method of claim 72, wherein said recording of said control information is on said one or more second media, and wherein said one or more second media is the CD-ROM portion of said CD.

74. The method of claim 71, wherein M equals N.

75. The method of claim 74, wherein said residual contains (N-2) independent channels.

76. The method of claim 74, wherein said residual contains less than (N-2) independent channels.

77. The method of claim 71, further comprising:
compressing said residual prior to its recording.

78. The method of claim 77, wherein control information contains data on how said residual is compressed.

79. The method of claim 71, wherein the deriving from said N-channel audio signal a two channel representation is based upon a linear combination of a finite set of spatial harmonics.

80. The method of claim 79, wherein said residual comprises a combination of zero and first order spatial harmonics which is linearly independent of said two channel representation.

81. The method of claim 71, wherein the recording of said first medium is a rewritable memory.

82. The method of claim 81, further comprising:
compressing said two channel representation prior to its recording.

83. A compact disk (CD), comprising:
an audio portion wherein is stored a two track reduction of an N-channel master recording, wherein N is greater than two, and wherein said two track reduction is reproducible by playing said CD on a conventional audio CD player; and
a CD-ROM portion, wherein is stored data comprising:

control information; and

additional audio information, wherein said two track reduction and said additional audio information can be combined through use of said control information to reproduce an M-channel representation of said N-channel master recording, wherein M is greater than two but not greater than N.

84. The CD of claim 83, wherein said additional audio information is compressed.

85. The CD of claim 84, wherein control information contains data on how said additional audio information is compressed.

86. The CD of claim 83, wherein M equals N.

87. The CD of claim 86, wherein said additional audio information contains (N-2) independent channels.

88. The CD of claim 86, wherein said additional audio information contains less than (N-2) independent channels.

89. A method of storing N-channel audio data on a CD, wherein N is greater than two, comprising:

storing a two track reduction of said N-channel audio data, wherein said two track reduction is reproducible by playing said CD on a conventional audio CD player; and

storing control information on said CD; and

storing additional audio data on said CD outside of said audio portion, wherein said two track reduction and said additional audio information can be combined through use of said control information to reproduce an M-channel representation of said N-channel audio data, wherein M is greater than two but not greater than N.

90. The method of claim 89, wherein said additional audio information is compressed.

91. The method of claim 90, wherein control information contains data on how said additional audio information is compressed.

92. The method of claim 89, wherein M is equal to N.

93. The method of claim 92, wherein said additional audio information contains (N-2) independent channels.

94. The method of claim 92, wherein said additional audio information contains less than (N-2) independent channels.

95. A method for reproducing an N-channel audio signal, comprising:

reading a two channel representation of said N-channel said audio signal from a first medium;

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reading additional information from one or more second media, said

additional audio information derived from said N-channel

reconstructing an M-channel representation of said N-channel audio signal from said two channel representation and said additional audio information by use of said control information, wherein M is greater than two but not greater than N.

96. The method of claim 95, wherein said first medium is the

97. The method of claim 96, wherein said one or more second

98. / The method of claim 95, wherein said additional audio

expanding said additional audio information prior reconstructing said

99. The method of claim 98, wherein the expanding of said

100. The method of claim 95, wherein M is equal to N.

101. The method of claim 100, wherein said additional audio

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102. The method of claim 100 wherein the representation contains less than $(N-2)$ independent components.

103. The method of claim 9 wherein the representation is based upon a linear combination of components derived from said N -channel audio signal.

104. The method of claim 103 wherein the representation comprises a combination of zero and first order components, and the components are mutually independent of said two channel representation.

105. The method of claim 9 wherein the representation is contained in a rewritable memory.

106. The method of claim 10 wherein the representation is compressed, further comprising:
expanding said two channel representation to a full channel representation.

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102. The method of claim 100 wherein the representation contains less than $(N-2)$ independent components.

103. The method of claim 9 wherein the representation is based upon a linear combination of components derived from said N -channel audio signal.

104. The method of claim 103 wherein the representation comprises a combination of zero and first order components, and the components are mutually independent of said two channel representation.

105. The method of claim 9 wherein the representation is contained in a rewritable memory.

106. The method of claim 10 wherein the representation is compressed, further comprising:
expanding said two channel representation to a full channel representation.

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102. The method of claim 100 wherein the representation contains less than $(N-2)$ independent components.

103. The method of claim 9 wherein the representation is based upon a linear combination of components derived from said N -channel audio signal.

104. The method of claim 103 wherein the representation comprises a combination of zero and first order components, and the components are mutually independent of said two channel representation.

105. The method of claim 9 wherein the representation is contained in a rewritable memory.

106. The method of claim 10 wherein the representation is compressed, further comprising:
expanding said two channel representation to a full channel representation.

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102. The method of claim 100 wherein the number of independent channel representations contains less than $(N-2)$ independent channel representations.

103. The method of claim 99 wherein the number of independent channel representations is based upon a linear combination of the number of independent channel representations derived from said N -channel audio signal.

104. The method of claim 103 wherein the number of independent channel representations comprises a combination of zero and first order independent channel representations of said two channel representation.

105. The method of claim 99 wherein the number of independent channel representations is contained in a rewritable memory.

106. The method of claim 100 wherein the number of independent channel representations is compressed, further comprising:
expanding said two channel representation to a number of independent channel representations.